

# SURGICAL MICROSCOPE APPARATUS

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## Cross Reference to Related Cases

The application claims the benefit of and incorporates by reference in their  
5 entirety both U.S. Provisional Patent Application 60/416,341 filed 10/04/2002 and U.S.  
Provisional Patent Application 60/399,260 filed 7/29/2002.

## Description of the Invention

The present invention relates generally to microscope systems for use in surgery,  
10 and more particularly to a system which is well suited for dentistry and oral surgery.

## Background of the Invention

Stands for locating and positioning surgical microscopes are known from U.S.  
Patent 4,170,336 as well as U.S. Patent 5,213,293 among others. Depending upon the  
medical application and the orientation of the patient, it is desirable to have a surgical  
15 microscope movable in and out of the operating field so that it is readily available for  
use by the attending physician. Microscopes are now typically equipped with accessory  
modules including CCD cameras. The addition of these ancillary devices increases the  
bulk of the microscope and makes it more difficult to achieve a system that can be easily  
operated by the physician.  
20 In use the typical method of use is too position the microscope with respect tot he  
patient's mouth and then place the physicians head at the oculars of the microscope.  
This process can place the physician in an awkward position. As a result many  
physicians prefer to use eye loupes attached to the physicians head. Fatigue and motion  
of the physicians head limits the effective magnification power of the eye loupe to a  
25 very low power.

## Summary of the Invention

The present invention provides a coupler that allows a conventional microscope  
to be mounted on an articulated arm. This arm couples the microscope to a vertical  
30 support. The vertical support and articulated arm permit the microscope to move in a  
horizontal plane.

The vertical support is coupled to a patient support structure which is preferably  
a dental chair. Manipulation of the dental chair height allows the eye tubes to be

brought to a comfortable position for the attending physician whether seated or standing. The eye tubes of the microscope are positioned for convenient use by the attending physician by operation of the patient chair "height" control.

5        Rough focus of the microscopic surgical field is achieved by rotation of the patient back support. Rotation about a pivot point in the patient support permits the surgical field of view to be moved with respect to the microscope. In this fashion, focus is achieved by moving the patient in the surgical field rather than moving the microscope. Of course, fine focusing is still available within the microscope itself, but the overall field of view and the like is defined by motion of the patient with respect to  
10      the microscope.

#### Brief Description of Drawings

Throughout the figures like reference numerals refer to identical structure throughout wherein:

15        Figure 1 shows the overall system;  
          Figure 2 shows a portion of the system in isolation;  
          Figure 3 shows a support for coupling the articulated arm to the microscope;  
          Figure 4 is a drawing showing the adapter for mounting the microscope on the arm;  
20        Figure 5 is a drawing of the adapter; and ,  
          Figure 6 is a drawing of an alternate embodiment of the arm.

#### Detailed Description of the Preferred Embodiments

25        In Figure 1 the physician 10 is using a surgical microscope 12 to visualize a surgical field within the mouth of patient 14. The patient 14 is shown in phantom view so that the hands of the physician 10 manipulating controller 16 can be observed. The microscope 12 is connected by coupler 20 to the articulated arm assembly 22 which in turn is connected to the vertical support 24. The arm 22 terminates in an adjustable  
30      clamp mount 26 which can be positioned along the length of the vertical support 24. Moving the clamp 26 along the vertical support 24 allows for initial positioning of the microscope 12 to place it in the approximate correct position for operation by the physician 10, and in the correct orientation over the patient 14. It is preferable that the

vertical support 24 be attached directly to the dental chair 26. In general the vertical location of the scope is selected to provide a comfortable ocular position for the physician 10.

Preferably, the process starts with motion of the dental or surgical chair 26. The chair 26 itself can be raised or lowered as indicated by arrow 28 through the use of a control 30. The attending physician 10 will use this adjustment to bring the microscope 12 oculars into a comfortable operating position. With the field of view selected through operation of the microscope 12, the surgical field is brought into precise focus through the use of controller 16 which moves the patient into the surgical field of view by rotation around pivot 32 indicated by arrow 31. The chair pivot 32 is located near the patient's hips and accommodating this motion is comfortable for the patient. Thus as a consequence of rotation about pivot 32 the patient's mouth moves into the surgical field without affecting the static position of the vertical support arm 24. In the preferred configuration the vertical support arm can move vertically and the pivot point can move vertical at the same time. However the rotation about pivot point 32 does not impact or alter the location of the microscope.

In use the physician will move the whole chair up or down to place the microscope occurs at a comfortable height. Next the physician will rotate the patient to bring the mouth in to approximate focus without moving the microscope.

The preferred dental chair will have a seat bottom that moves in a substantially vertical path. The preferred dental chair will have a seat back pivotally attached to the seat bottom which moves independently of the chair bottom such that the vertical motion of the chair does not affect microscope focus but chair pivot motion does impact focus.

Figure 2 shows the support arm 22 and related components in isolation. It is preferred that the support arm 22 be made up of a plurality of individual articulated arms or links typified by link 40. It is preferable that each end of the link be terminated in a vertically oriented hinge element so that the microscope 12 may be moved freely in a plane defined by the rotational motion about the respective vertical axes 41a, 41b, 41c of the hinge points. This construction permits the physician 10 to quickly, easily position the microscope 12 over a surgical field without being concerned about disturbing the vertical position of the microscope 12. It is preferable to have at least four arms to provide an adequate range of movement for dental applications. The coupler 20

and the hinge mechanisms of the articulated arm 22 must be sufficiently rigid to support the microscope 12 without vibration or untoward motion. Typically the arms 40 and the vertical support 24 are extremely stiff to ensure that no vibration occurs during the use of the system.

5           Figure 3 shows one form of coupler 20 which can be readily used to mount a conventional surgical microscope to a conventional articulated support arm. Flange 53 includes an upper anti-rotation pin 51 mounted in the upper support plate 52. The flange forms a crossbar, which provides a mounting location for the pin 55 which fits  
10           within an aperture in support arm 40. This allows rotation of the microscope assembly around the axis 58 shown in the figure. Additional anti-rotation pins 56 and 57 may be required for connection to the microscope 12 to prevent it from twisting in the mount and for maintaining perpendicular orientation over the surgical field. It is conventional practice to provide a support screw for mounting the microscope 12 and aperture 57 is provided to rigidly mount the microscope 12 to the coupler 20.

15           Figure 4 shows a preferred form of adapter in a different view showing the microscope mounting surface of the device. Once again, the screw supplied through aperture 57 holds the microscope against the alignment pins 51 and 56 to prevent it from twisting around the axis defined by aperture 57.

20           Figure 5 shows a side view of the device. In this view the flange 53 can be seen to support the pin 55 in a cantilever fashion. The position of the aperture 57 and the alignment pins 51 and 56 depend on the particular microscope design while the shape and location of the pin 55 depends on detailed design of the articulated arm assembly 22.

25           Figure 6 shows an alternate but preferred version of the device with an additional joint. The axis of joint 60 is orthogonal to the axis 41c. It is preferred to allow the microscope to rotate around this axis as indicated by motion arrow 62. It is expected that the motion in arc 62 will be limited and selected by a clevis pin 69. A clevis pin 69 with an associated ring 66 is illustrated in the figure. The clevis pin is placed into the holes in the joint mechanism 61 to restrict rotation about pivot axis pin 63. In use the  
30           physician will use one hand to hold the microscope and then use the other hand to remove the clevis pin 69 from the joint 60. With the pin out the physician can reposition the microscope at an alternate angle defined by the radial holes arrayed around the pivot point 63. Other schema may be used to provide motion and location around pivot

pin 63 including a “worm gear” and “sector gear” arrangement with the sector gear mounted on the axis of rotation, Another alternative is a “ball joint” mechanism. In use the angular orientation of the microscope aids in the comfort of the user and also allow the depth of focus to reach farther in to the patient’s mouth. Each clevis pin position

5 should provide about 5 additional degrees of rotation.